NASA TECH BRIEF

Fortran Optical Lens Design Program

The problem:

A need for optical systems which are optimal in performance, as measured by a merit function. The optical designs must be quickly produced.

The solution:

A computer program which uses the principles of geometrical optics to design optical systems containing up to 100 planes, conic or polynomial aspheric surfaces, 7 object points, 6 colors, and 200 rays. This program can be used for the automatic design of optical systems or for the evaluation of existing optical systems.

How it's done:

The program is made up of 48 subroutines. In the design phase, it uses a linearized least squares technique to iteratively reduce the magnitude of the merit function by automatically adjusting system parameters. The merit function is the length of the error vector, the components of which are the weighted deviations from the mean of ray coordinates at the image.

Among the user selected options are: design computation, spot diagram computation, twin ray diagnostic maximum object, twin ray diagnostic zero object, and sensitivity computations.

The user can also choose weights which are combined with spot size to make up the merit function. These weights control the: (1) focal length deviation; (2) exit pupil deviation; (3) spot size for each object point; (4) spot size for each specified color; (5) spot diagram size in the x-direction; (6) spot diagram size in the y-direction; (7) lateral chromatic aberration for each object point; and (8) image height deviations for each object point.

The individual rays of the specified ray pattern are traced from the object points through the lens system to a point on the last lens surface by using a three-step iterative procedure. The coordinates of each ray on each surface and the direction of each ray following refraction (which here includes reflection as a special case) are found at each surface from the coordinates and direction of the ray at the preceding surface. Focal point, focal length, back focus, f number, and exit pupil location are found for every color. The pattern of points resulting from the initial ray pattern describes on the image a monochromatic spot which can be plotted out.

Notes:

1. This program was written in Fortran IV for use on the IBM 7094 computer with SC 4020 plotter.
2. Any number of cases can be processed in a single computer run.
3. Inquiries concerning this program may be made to:
   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B68-10354

Patent status:

No patent action is contemplated by NASA.

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Category 06